Yevtushenko, N., Villa, T., Brayton, R., Petrenko, A., and Sangiovanni-Vincentelli, A. "Solution of Language Equations for Logic Synthesis" In *Proceedings of the IEEE 10th International Workshop on Logic & Synthesis (IWLS 2001)*. Granlibakken Conference Center, Lake Tahoe, California, USA, June 12-15, 2001.

Abstract

The problem of designing a component that combined with a known part of a system, conforms to a given overall specification arises in several applications ranging from logic synthesis to the design of discrete controllers. We cast the problem as solving abstract equations over languages. Language equations can be defined with respect to several language composition operators such as synchronous composition, $\bullet$, and parallel composition, $\Diamond$; conformity can be checked by language containment. In this paper we address parallel language equations. Parallel composition arises in the context of modeling delay-insensitive processes and their environments. The parallel composition operator models an exchange protocol by which an input is followed by an output after a finite exchange of internal signals. It abstracts a system with two components with a single message in transit, such that at each instance either the components exchange messages or one of them communicates with its environment, which submits the next external input to the system only after the system has produced an external output in response to the previous input. We study the most general solutions of the language equation $A \Diamond X \subseteq C$, and define the language operators needed to express them. Then we specialize such equations to languages associated with important classes of automata used for modeling systems, e.g., regular languages and FSM languages. In particular, for $A \Diamond X \subseteq C$, we give algorithms for computing: the largest FSM language solution, the largest complete solution, and the largest solution whose composition with A yields a complete FSM language. We solve also FSM equations under bounded parallel composition. In this paper, we give concrete algorithms for computing such solutions, and state and prove their correctness.